



Nowcasting the Wind Speed During a Hurricane at Sea

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Nowcasting is a description of current weather and a short-term forecast varying from minutes to a few hours (see Greer, 1996). During a hurricane, nowcasting is needed to supplement the “official” forecast by the National Weather Service to steer the ship away from the danger imposed by the storm. Nowcasting of the wind speed is a way to avoid the danger. The methodology is as follows.

According to Anthes (1982, p. 22 and Fig. 2.8),

$$U_{10Y} = U_{10\max} \left(\frac{R}{Y} \right)^{0.5} \quad (1)$$

where U_{10Y} is the sustained wind speed at 10 m at a distance away from the storm center, and $U_{10\max}$ is the maximum sustained wind speed at 10 m at the radius of maximum wind, R .

According to Hsu et al. (2000), for operational applications,

$$\frac{R}{Y} = \ln \left(\frac{1013 - P_0}{P_Y - P_0} \right) \quad (2)$$

where P_0 is the minimal sea-level or central pressure of the hurricane, P_Y is the pressure at a point located at a distance from the storm center, and \ln is the natural logarithm.

Substituting Equation (2) into (1), we have

$$U_{10Y} = U_{10\max} \left[\ln \left(\frac{1013 - P_0}{P_Y - P_0} \right) \right]^{0.5} \quad (3)$$

According to Hsu (2003, this issue),

$$U_{10\max} = 6.3 (1013 - P_0)^{0.5} \quad (4)$$

Therefore, U_{10Y} can be nowcasted by Equations (3) and (4) using only a scientific calculator.

A verification of the above method is provided in **Figure 1**. During Hurricane Lili in 2002, the National Data Buoy Center (NDBC) had two buoys, #42001 located near R, and #42003 located due east along 26°N , approximately 280 km from 42001. The wind speed measurement was 10 m for both buoys. From the National Data Buoy Center (NDBC) Web site (<http://www.ndbc.noaa.gov/>) we have at 20Z 2 October 2002 at #42001, $P_0 = 956.1$ mb. Substituting this P_0 into Equation (4), $U_{10\max} = 47.5$ m/s, it is in excellent agreement with the measured value of 47.2 m/s. Therefore, Equation (4) is further verified. At the same time, $P_Y = 1011.1$ mb was measured at #42003. Substituting this P_Y into Equation (3), we obtain

$$\begin{aligned} U_{10Y} &= 47.5 \left[\ln \frac{1013 - 956.1}{1011.1 - 956.1} \right]^{0.5} \\ &= 47.5 \left[\ln \frac{56.9}{55.0} \right]^{0.5} \\ &= 47.5 \left[\ln 1.03 \right]^{0.5} \\ &= 8.8 \text{ m/s} \end{aligned}$$

The measured U_{10Y} at 42003 was 9.2 m/s. Since the difference between 8.8 and 9.2 is $(9.2 - 8.8)/9.2$ or approximately 4%, we conclude that Equations (3) and (4) can be used for nowcasting using the shipboard pressure measurement and P_0 which is available via official “Advisory” during a hurricane.

References

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- Geer, I. W. (Editor), Glossary of Weather and Climate (American Meteorological Society, Boston, MA, 1996, 272 pp).
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- Hsu, S. A., *Estimating hurricane-induced maximum sustained wind speed at 10 m from its central pressure at sea* (Mariners Weather Log, 2003, this issue). ☼



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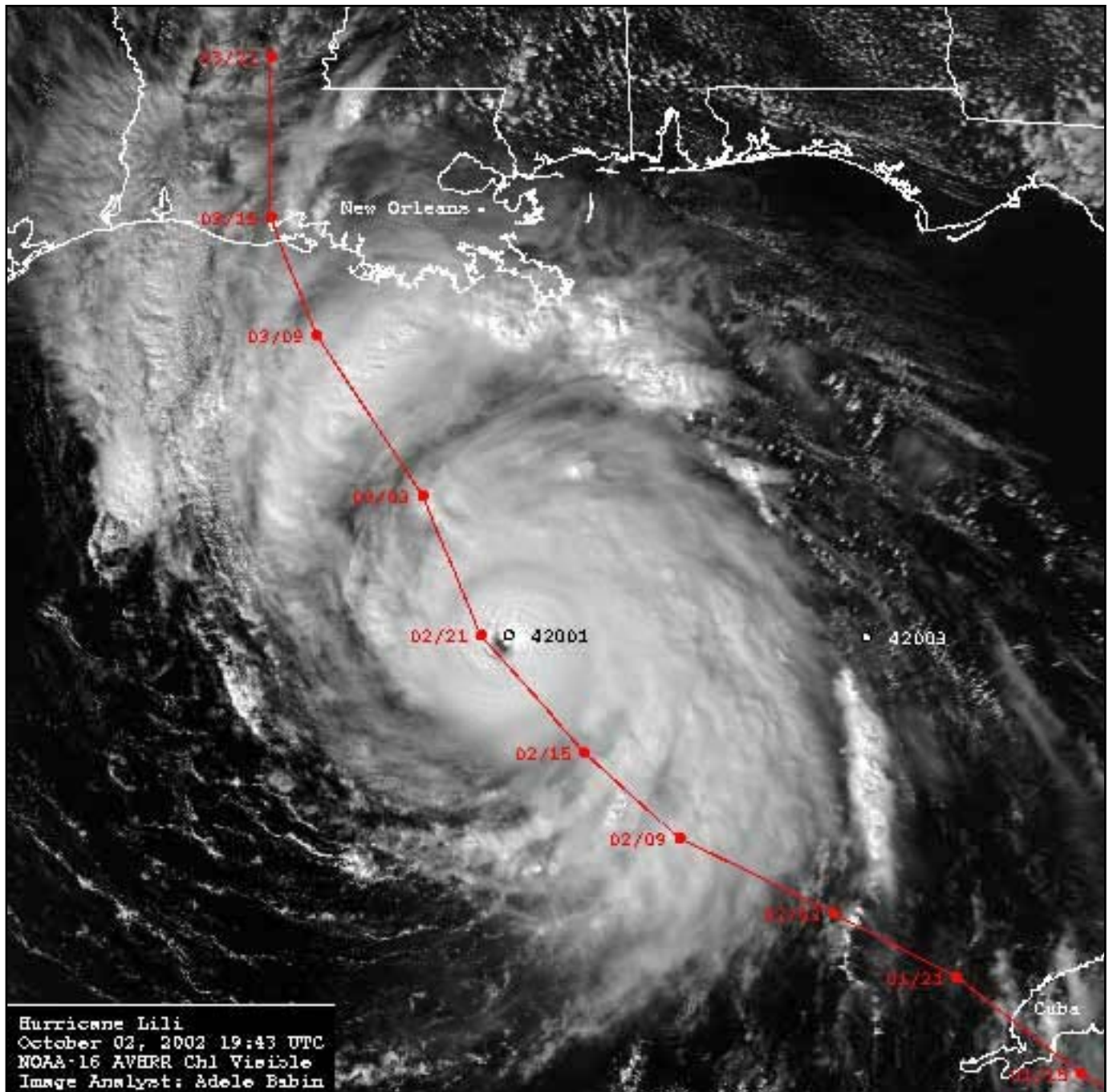


Figure 1. Satellite data (visible channel from NOAA-16) received and processed at the Earth Scan Lab, Louisiana State University, during Hurricane Lili (2002) in the Gulf of Mexico. The solid line represents the storm track. Data from NDBC buoys 42001 and 42003 are employed in this study.